TERNATIONAL FOOD INFORMATION SERVICE

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NITROSAMINES

SELECTED FROM VOLUME 13
FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

der the direction of:-

mmonwealth Agricultural Bureaux, Farnham Royal, Slough; Gesellschaft fur Information und kumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor ndbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

INTRODUCTION

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Coverage of the subject has been restricted to that of Food Science and Technolggy Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

[Nitrosamine analysis.]
Castegnaro, M.; Walker, E. A.
Analusis 8 (4) 125–129 (1980) [31 ref. Fr. en] [Cent. Int. de Recherche sur le Cancer, 150 Cours Albert Thomas, 69372 Lyon Cedex 2, France]

After a historical review of nitrosamine detn. methodology, the new 'thermal energy analyser' (TEA) detector is described and its limitations discussed. The response of the detector for most nitrosamines is linear between 0.5 and 1000 ng, for nitrosodimethylamine (NDMA) between 0.1 and 10 000 ng; detection limit is <0.1 ng for NDMA and its ethyl homologue, and 0.2 ng for nitrosopyrrolidine. The detector was used for detn. of volatile nitrosamines in combination with GLC or HPLC and for detn. of non-volatile nitrosamines in combination with HPLC. Tabulated results from several collaborative studies on minced pork show that results of TEA detn. were subject to smaller deviations than GLC or MS (coeff. of variation for 4 *N*-nitrosamines 10.2–25.7%, vs. 24.2–51.8 and 18.0–41.8% resp.). RM

2

[Some carcinogenic compounds in foods.] [Review]
Jovanovic, K.
Prehrambeno Tehnoloska Revija 16 (1) 16–20 (1978) [67 ref. Sh, en] [Prehrambeno-Tehnoloski Inst., Zagreb, Yugoslavia]

This review considers the following topics: nitrates, nitrites and secondary amines as sources of nitrosamines in foods; polycyclic aromatic hydrocarbons in foods; carcinogenic effects of the named substances; and methods of their detn. SKK

3

[Interaction of dimethylnitrosamine and wheat bran.]
Cattaneo, P.; Cantoni, C.
Tecnica Molitoria 31 (3) 222–224 (1980) [14 ref. It, en] [Istituto di Ispezione degli Alimenti, Fac. di Med. Vet., Univ. degli Studi di Milano, Milan, Italy]

Studies were conducted on binding of dimethylnitrosamine (DmNA) by bran in 2 products: (i) containing bran and sodium caseinate and (ii) containing bran, sugar, salt and malt. 50 ml of citrate buffer (pH 2 or pH 7) containing 10 p.p.m. DmNA were mixed with 0.5, 1, 2, 3, 4 or 8% (i) or (ii), held for 30 min at 37°C, filtered and centrifuged, and the non-bound DmNA hydrolysed under UV irradiation and the resulting nitrous acid determined by a sulphanilic acid/α-naphthylamine spectrophotometric method. A table of results is given. The % of DmNA bound at (i) concn. of 0.5 and 8.0% resp. were 6.0 and 43.5 at pH 2, vs. 37.0 and 68.2 at pH 7. Corresponding values for (ii) were 14.5 and 38.0% at pH 2, and 33.3 and 52.8% at pH 7. AJDW

4

[Absorption of diphenylnitrosamine by bran products.]
Cattaneo, P.; Cantoni, C.
Tecnica Molitoria 31 (6) 470–472 (1980) [2 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. di Milano, Milan, Italy]

Studies on absorption of diphenylnitrosamine (DPNA) by (i) a bran/sodium caseinate or (ii) a bran/salt/malt product are described. 50 ml samples of citrate buffer (pH 2 or 7) containing 10 or 20 p.p.m. DPNA were mixed with 0.5, 1, 2, 3, 4 or 8% (i) or (ii), and held for 30 min at 37°C. The mixture was then filtered and centrifuged, and the non-bound DPNA was determined (after hydrolysis by UV irradiation) by detn. of the resulting nitrous acid by a sulphanilic acid/α-naphthylamine colorimetric method. A table of results is given. The % of DPNA bound at (i) concn. of 0.5 and 8.0% were, resp., 45.0 and 94.5 at pH 2, and 31.0 and 96.0 at pH 7. Corresponding values for (ii) were 11.0 and 89.0% at pH 2, and 15.0 and 86.0% at pH 7. AJDW

5

[Effect of enterotoxic staphylococci on formation of nitrosamines in muscle tissue of fish during salting.]
Zaleski, S.; Fik, A.; Daczkowska, E.; Koronkiewicz, A.; Stopikowska, I.
Medycyna Weterynaryjna 35 (1) 25–29 (1979) [12 ref. Pl, ru, en] [Inst. Tech. Zywnosci Pochodzenia Morskiego, AR, Szczecin, Poland]

Fresh Baltic herring in ice, and frozen cleaned mackerel were salted directly or after storage for 6 days at 1°C. Portions of 2 batches of each type of herring were salted with sea salt containing 600 p.p.m. nitrates and 0.2 p.p.m. nitrites, or with cooking salt containing 240 p.p.m. nitrates and 0.1 p.p.m. nitrites, or with fisherman's salt containing 210 p.p.m. nitrates and free from nitrites, each salt being used at 1 kg/4 kg fish. After 1 day, when brine had formed, a suspension of a *Staphylococcus aureus* strain was added to each 3-kg portion of herring to give an initial cell content of 4×10^5/ml brine; the portions were then stored at 6°C for 3 wk, and brine and herring were sampled at intervals. Mackerel was immersed before salting in brine containing *S. aureus* at 5×10^5 cells/ml, and were then salted with the 3 types of salt according to official instructions, the tubs being closed with weighted lids and stored at 22–28°C for 2 months; brine and mackerel were sampled at intervals. Survival of *S. aureus* during storage is graphically presented for all variants; all showed gradual disappearance of the contaminants. No nitrosamines were detected in any of the variants examined after 7-days storage. 112 samples of anchovies from Spain, Portugal and Yugoslavia were examined. No coagulase-positive staphylococci were detected in any of them; counts of anaerobic sporeformers ranged from 0 to 24/g, only 11.6% of samples containing >10/g. No nitrosamines were found in 12 of the 112 samples taken at random. SKK

6

Dimethylnitrosamine in malt beverages; availability of guide.
United States of America, Food & Drug Administration
Federal Register 45 (113, June 10) 39341–39342 (1980) [En] [Washington, DC, USA]

Dimethylnitrosamine (DMNA) is formed when malt is kilned by an open flame as a result of a reaction between amines, naturally present in barley, and NO formed during combustion of the fuel. Processing is being modified by addition of S to the open flame which

substantially reduces nitrosamine formation. A 5 parts/billion regulatory action level is being established for DMNA as the lowest practicable level which can be confirmed by reliable methodology. CAS

7

[The effects of pH of sample solutions and addition of alkali and/or ascorbate on the yield of N-nitrosodimethylamine during extraction process.]
Tozawa, H.
Bulletin of the Japanese Society of Scientific Fisheries [Nihon Suisan Gakkai-shi] 45 (12) 1585 (1979) [2 ref. Ja] [Tokai Reg. Fisheries Res. Lab., Chuo-ku 104, Tokyo, Japan]

8

Environmental contaminants as carcinogens.
Munn, J. I.
Association of Food and Drug Officials, Quarterly Bulletin 43 (1) 13-29 (1979) [14 ref. En] [Nat. Cancer Inst., Bethesda, Maryland 20014, USA]

In a wide-ranging review of environmental carcinogens, reference is made to the occurrence of carcinogens and co-carcinogens in drinking water, to the formation of polycyclic aromatic hydrocarbons in foods (notably benzo(a)pyrene), to the incidence of carcinogenic metabolites of fungi in food and feed, to the intentional addition of chemicals to food which are tumorigenic in test animal species, including food colours, and to nitrosamines in foods. Other topics briefly discussed include metal carcinogenesis (As, Cd and Se) and possibly carcinogenic pesticide residues in foods. JRR

9

[Nitrate, nitrite and nitrosamines in foods. Improved production hygiene as an alternative to use of nitrite.] [Review]
Skovgaard, N.
Nordisk Veterinaermedicin 32 (9) 387-399 (1980) [37 ref. Da, en] [Inst. for Vet. Mikrobiologi & Hygiejne, Den Kongelige Vet. & Landbohojskole, Copenhagen, Denmark]

Aspects considered in this review include: the relationship between microbial count and keeping quality of foods; effects of environmental conditions on microbial growth; the significance of resistance of bacteria to preservatives; counts of spores (especially *Clostridium botulinum* spores) in foods; the implications of the spore count for effects of nitrite in heat-treated meat products; necessary nitrite concn. for inhibition of *Cl. botulinum* and saccharolytic clostridia; formation of nitrite from nitrate; potentiating and antagonistic effects of other additives or constituents (ascorbate, isoascorbate, sorbate, phosphate, Fe) on effects of nitrite in meat products; application and effects of nitrite in raw, cured and refrigerated meat products; and advantages of low initial counts in foods to be preserved with nitrite (i.e. lower nitrite concn. required). AJDW

10

Nitrites and nitrosamines in meat food products. Food Safety and Quality Service.
United States of America, Department of Agriculture
Federal Register 45 (126, June 27) 43447-43452 (1980) [En] [Washington, DC, USA]

The current test procedure for the detection and detn. of nitrosamines in meat food products by the USDA is to utilize a Thermal Energy Analyser (TEA) to screen samples. Samples containing ≥ 10 parts/billion are subject to confirmation by the gas chromatography/MS (GC/MS). Tests have failed to find confirmable levels of nitrosamines in uncooked pumped bacons. Nitrosation (resulting in nitrosamine formation) apparently results from the heat of cooking. From 5 to 17% of the TEA-tested samples contained nitrosamines at levels expected to be confirmed by GC/MS. A high incidence of confirmable levels of nitrosamines were found in bacon (cured pork bellies) made with dry curing materials. With dry cured hams and pork shoulders, GC/MS results were consistently and appeciably lower than findings by TEA on the same samples. A problem may exist with immersion cured bacon but too few samples were examined to be representative. Confirmable levels of nitrosamines were not found in fermented sausages, cooked sausages, pickle-cured products (other than immersion cured bacon), perishable canned products, shelf-stable products, or sterile canned products. CAS

11

Regulatory aspects of carcinogenesis and food additives: the Delaney Clause. [Book]
Coulston, F. (Editor)
xxiv + 397pp. ISBN 0-12-192750-4 (1979) [many ref. En]
London, UK; Academic Press Inc. (London) Ltd. [Inst. of Comparative & Human Toxicology, Albany Med. Coll. of Union Univ., Albany, New York, USA]

This publication comprises a series of papers on legislation related to carcinogenicity of food additives, with special reference to the Delaney Clause, including the following. Public policy issues in regulating carcinogens in food, by P. B. Hutt (pp. 9-23). The Delaney Clause: an experimental policy decision that has been misinterpreted, by W. M. Upholt (pp. 27-31). The regulation of carcinogens at the Environmental Protection Agency, by R. Albert & E. Anderson (pp. 33-39). By appropriate methods: the Delaney Clause, by H. F. Kraybill (pp. 61-82, 26 ref.). Alternatives to be considered in benefit: risk decision-making, by W. J. Darby (pp. 83-92, 5 ref.). Question-making issues relevant to cancer-inducing substances, by A. C. Kolbye, Jr. (pp. 93-102). The Delaney Clause: an idea whose time has come for a change, by J. G. Martin (pp. 121-125). The predictive value of animal tests for carcinogenicity, by W. Lijinsky (pp. 127-132). The design criteria and application of dose-response relationships to interpretation of carcinogenesis bioassay, by M. F. Cranmer & N. Littlefield (pp. 147-172, 4 ref.). The role of the endoplasmic reticulum in carcinogenesis, by D. V. Parke (pp. 173-187, 47 ref.). Chemically induced tumors - their relationship to human cancer, by W. H. Butler (pp. 189-199, 20 ref.). Metabolism and photodegradation of chlorinated

hydrocarbons and their potential in carcinogenesis, by F. Korte (pp. 233–238). Experimental procedures in the evaluation of chemical carcinogens, by C. J. Kensler (pp. 239–249, 12 ref.). Negative health implications of the Delaney philosophy, by J. P. Frawley (pp. 253–260). The use of nonhuman primates for chemical carcinogenesis studies, by R. H. Adamson & S. M. Sieber (pp. 275–296, 10 ref.). Extrapolating animal risk to humans, by E. L. Wynder (pp. 305–311, 18 ref.). Assessments at an international level of health hazards to man of chemicals shown to be carcinogenic in laboratory animals, by F. C. Lu (pp. 315–325). The establishment of European Community legislation for toxic substances, by J. Smeets & W. Hunter (pp. 329–338). Impact of the Delaney Clause on the research-intensive manufacturer of biomedical products, by R. H. Furman (pp. 343–352, 5 ref.). Impact of the Delaney Clause philosophy on the chemical industry, by E. H. Blair (pp. 353–359). The Delaney Clause relation to the development of chemical carcinogenesis, by D. B. Clayson (pp. 361–371). A 7-pp. subject index is included. AJDW

12

Volatile nitrosamines in human blood before and after ingestion of a meal containing high concentration of nitrate and secondary amines.
Yamamoto, M.; Yamada, T.; Tanimura, A.
Food and Cosmetics Toxicology 18 (3) 297–299 (1980) [15 ref. En] [Natl. Inst. of Hygienic Sci., Setagayu-ku, Tokyo, Japan]

In order to assess the effects of the Japanese diet on the levels of nitrosamines in the blood, a meal containing high levels of nitrate and secondary amines was consumed by 8 Japanese volunteers. The meal consisted of rice, roasted mackerel, roasted cod roes, pickled radishes, dried strips of radishes, soup containing fish balls and salted Chinese cabbage. Levels of nitrosamines were studied in blood samples taken before and after ingestion of the meal.
Nitrosodimethylamine was detected in all 32 blood samples from 8 donors in amounts ranging from a trace (<0.5 ng/ml) to 1.3 ng/ml. The results did not show any clear effects of the meal on the levels of nitrosamines in the blood at least for periods up to 2 h after the meal. The results suggest the possibility of nitrosamine formation in the lower gastro-intestinal tract. VJG

13

Effect of betel-quid chewing on nitrite levels in saliva.
Shivapurkar, N. M.; D'Souza, A. V.; Bhide, S. V.
Food and Cosmetics Toxicology 18 (3) 277–281 (1980) [24 ref. En] [Carcinogenesis Div., Cancer Res. Inst., Bombay 400 012, India]

Effects of chewing betel quid, alone or with tobacco, on salivary levels of nitrite and other factors of importance in the formation of nitrosamines were studied. The possible relevance of the findings to the development of oral cancer was assessed. It was found that habitual tobacco chewers did not show nitrite values as high as those in non-chewers. They also failed to show any increase in salivary nitrites after chewing betel quid with or without tobacco. Free amino-N levels in the saliva were not affected significantly by chewing either tobacco or betel quid, while salivary pH was increased by both types of test chew. Thiocyanate levels were significantly higher in habitual tobacco chewers than in non-chewers, and were further increased after the chewing of betel quid with tobacco. VJG

14

Effect of malondialdehyde on nitrosamine formation.
Kurechi, T.; Kikugawa, K.; Ozawa, M.
Food and Cosmetics Toxicology 18 (2) 119–122 (1980) [21 ref. En] [Tokyo Coll. of Pharm., 1432-1 Horinouchi, Hachioji, Tokyo 192-03, Japan]

Several aldehydes that occur in foods were investigated for their effects on nitrosamine formation. Malondialdehyde, which can be derived from lipids by peroxidation, greatly influenced the reaction, decreasing the formation of nitrosamine at pH 3 and increasing it at pH 4–7. Glucose, benzaldehyde, furfural and glyoxal had little influence on nitrosamine formation. Both the inhibitory and the promoting effects of malondialdehyde were dependent on the concn. VJG

15

Microbiological safety of pasteurized cured meats: inhibition of *Clostridium botulinum* by curing salts and other additives. (In *'Food microbiology and technology'* [see FSTA (1981) 13 3B17].) [Lecture]
Jarvis, B.; Rhodes, A. C.; Patel, M.
pp. 251–266 (1979) [16 ref. En, it] [Leatherhead Food Res. Ass., Leatherhead, Surrey, UK]

An approach to understanding factors affecting safety in pasteurized cured meats, with special regard to formation of nitrosamines (potential carcinogens from nirite) is described. A series of investigations was made into inhibition of toxin formation by *Clostridium botulinum* by salt, nitrite, polyphosphate, sorbic acid, storage temp., thermal process value and pH. Major interactions occur; these are discussed with reference to the potential for reducing individual inhibitors to as low a level as possible. The implications of changes in legislative, industrial and consumer requirements are outlined in relation to continuing safety requirements of such products. LH

16

Mutagenicity of 2-alkyl-*N*-nitrosothiazolidines.
Sekizawa, J.; Shibamoto, T.
Journal of Agricultural and Food Chemistry 28 (4) 781–783 (1980) [22 ref. En] [Ogawa & Co. Ltd., 1-12-3 Niitaka Yodogawa-Ku, Osaka, Japan]

N-Nitrosothiazolidine and its 2-alkyl derivatives, which formed in the browning reaction with nitrite, were tested for mutagenicity by using the Ames *Salmonella*/microsome mutagenicity assay. Some *N*-nitrosothiazolidines showed positive mutagenic responses toward *S. typhimurium* TA 100, and the order of mutagenic potency relative to their 2-alkyl substituents was as follows: unsubstituted > isopropyl > propyl > ethyl > butyl > isobutyl > methyl. The metabolic activation system (S-9 mix) was not required to detect mutagenicity. In fact, the addition of S-9 mix strongly suppressed the mutagenic activity of *N*-nitrosothiazolidines. The factors which caused deactivation of the mutagens in S-9 mix were also investigated. AS

17

[Mutagenicity testing: an early warning system for genetic damage and cancer?] Mutagenitäts-Prüfung, ein Frühwarnsystem gegen Erbschäden und Krebs?
Wild, D.; Harnasch, D.
Umschau in Wissenschaft und Technik 80 (22) 682-687 (1980) [10 ref. De, en] [Zentrallab. für Mutagenitätsprüfung der Deutschen Forschungsgemeinschaft, Breisacher Strasse 33, 7800 Freiburg, Federal Republic of Germany]

A general discussion is presented on screening for mutagens, with reference to various test methods. The mutagenicity and possible correlation with carcinogenicity of various products, including food preservatives, are discussed. RAW

18

[Changes in nitrite in cured meat products.] [Review]
Goutefongea, R.
Viandes et Produits Carnes 1 (4) 6-11 (1980) [77 ref. Fr] [Sta. de Recherches sur la Viande, INRA, Theix-63110 Beaumont, France]

Aspects considered in this review include: chemical characteristics and reactions of nitrite; nitrosamine formation; analysis of nitrite; free and bound nitrite in meat products; 'disappearance' of nitrite in cured meat products; the role of nitrite in colour and flavour formation in meat products; oxidant and antioxidant characteristics of nitrite; formation of nitrate from nitrite; and reaction of nitrite with pigments, amino acids, proteins, carbohydrates and adipose tissue. AJDW

19

Identification of alkylureas after nitrosation-denitrosation of a bonito fish product, crab, lobster, and bacon.
Mirvish, S. S.; Karlowski, K.; Cairnes, D. A.; Sams, J. P.; Abraham, R.; Nielsen, J.
Journal of Agricultural and Food Chemistry 28 (6) 1175-1182 (1980) [37 ref. En] [Eppley Inst. for Res. in Cancer, Univ. of Nebraska Med. Cent., Omaha, Nebraska 68105, USA]

In vivo production of nitrosoureas from food constituents and nitrite might contribute to the aetiology of gastric cancer. Extracts of 13 different foods were treated with nitrite at pH 1 and left at pH 0 to effect denitrosation. The resulting alkylureas (which may have arisen from intermediate alkylnitrosoureas) were purified by cation-exchange, paper, and HPLC. Identity of most alkylurea samples was confirmed by high-resolution MS. A smoked, dried bonito fish product from Japan yielded an average of 340 µmol (25 mg) methylurea (MU)/kg fish; an intermediate product was shown to be methylnitrosourea. We obtained n-propylurea, 3-butenylurea, and [(4?)-hydroxybutyl]urea from dungeness crab and (mainly) 3-butenylurea from Alaskan king crab and slipper lobster tail. Fried bacon yielded an average of 350 µmol MU/kg food. The precursors of the alkylureas remain unidentified. The very large excess of nitrite used for the nitrosation makes the results less likely to be significant. AS

20

Dissipation of ^{14}C *N*-nitroso-di-n-propylamine (NDPA) from field soil and residue determinations in field-grown soybeans.
Berard, D. F.; Rainey, D. P.
Bulletin of Environmental Contamination and Toxicology 23 (1/2) 141-144 (1979) [4 ref. En] [Agric. Biochem., Lilly Res. Lab., Greenfield, Indiana 46140, USA]

Field soil was treated with ^{14}C NDPA by dissolving 377 µg in 1000 ml of water, and soybean seeds planted 8 days after application. Soybean plants were removed from treated and control plots 21 and 49 days after treatment, and soybean seeds were collected 119 days after NDPA application. Data obtained show the NDPA is rapidly dissipated from the soil primarily by volatilization, and that soybeans harvested from plants grown in such treated soil are free of residues of NDPA and NDPA transformation products. VJG

21

Nitrite-reacting substances in Japanese radish juice and their inhibition of nitrosamine formation [under gastric conditions].
Kurechi, T.; Kikugawa, K.; Fukuda, S.
Journal of Agricultural and Food Chemistry 28 (6) 1265-1269 (1980) [27 ref. En] [Dep. of Vet. Physiol. & Pharmacology, Texas A&M Univ., College Station, Texas 77843, USA]

22

Effect of preprocessing procedures for green bellies on *N*-nitrosopyrrolidine formation in bacon.
Pensabene, J. W.; Fiddler, W.; Miller, A. J.; Phillips, J. G.
Journal of Agricultural and Food Chemistry 28 (5) 966-970 (1980) [34 ref. En] [E. Reg. Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

Effect of preprocessing procedures to which green pork bellies are subjected on subsequent nitrosamine formation in fried bacon was studied by comparing fresh with refrigerated or frozen/thawed bellies and by comparing 3 thawing methods. Matched bellies were carried through treatments of (i) frozen storage at −18°C for 3 months + thawing at 1°C for 1 wk, (ii) storage from fresh at 1°C for 1 wk or (iii) processing from fresh. For thawing treatments bellies were stored at −18°C for 2 wk then thawed at 13°C for 24 h in air or 13°C for 6 h in water or at 1°C for 1 wk. Bellies were then cured, bacon was fried and nitrosamines were determined in edible portion and dripping. Results for *N*-nitrosopyrrolidine (NPYR) are tabulated in detail, together with residual nitrite contents in bacon and mean differences between treatments for NPYR levels. Refrigeration significantly increased NPYR levels in bacon and dripping vs. those for fresh treatments; mean (ii)-(iii) differences were 3.7 ± 1.0 and 5.4 ± 2.0 ng/g resp. Freeze-thawing also increased bacon and dripping NPYR content; mean (i)-(iii) differences were 2.7 ± 1.2 and 8.3 ± 1.7 ng/g resp. Values for other nitrosamines are not presented; the only significant difference in *N*-nitrosodimethylamine (NDMA) content between treatments was that NDMA in edible portion of bacon

NPYR content of dripping (but not bacon) was significantly increased in the room temp. and refrigerated treatments vs. the water thawed treatment, by 5.2 ± 1.3 ng/g and 9.5 ± 1.3 ng/g, resp. In all experiments there was a high correlation between residual nitrite content and NPYR content. DIH

23

Analysis of nitrosamines by GC^2 with a photoionization detector.

Meili, J.; Brönnimann, P.; Brechbühler, B.; Heiz, H.-J.

Journal of High Resolution Chromatography and Chromatography Communications 2 (7) 475–480 (1979) [6 ref. En] [Brechbühler AG, Steinwiesenstrasse 3, 8952 Schlieren, Switzerland]

The use of a photoionization detector (PID) coupled to a glass capillary gas chromatography (GC^2) separation system for the detection of carcinogenic nitrosamines was investigated. The components analysed gave a linear response with a lower detection limit of 50–100 pg with a 10.2 eV ionization source. No detector response was obtained with an ionization energy of 7.5 eV. Chromatography of meat extracts indicated their complex molecular composition. Simple liquid chromatographic cleaning procedures significantly decreased the complexity of these samples, but not sufficiently for accurate quantitation of nitrosamine components. AS

24

The catalysis of the N-nitrosation of secondary amines by nitrosophenols.

Davies, R.; Massey, R. C.; McWeeny, D. J.

Food Chemistry 6 (2) 115–122 (1980) [11 ref. En] [Min. of Agric., Fisheries & Food, Food Lab., Haldin House, Queen Street, Norwich, UK]

The catalytic effect of nitrosophenols on N-nitrosamine formation was studied, in view of the presence of phenolic compounds in smoked foods. Rate constants and reaction orders were determined for catalysis of the N-nitrosation of pyrrolidine and morpholine by *p*-nitrosophenols and the structurally related *p*-nitroso-N-alkylanilines and *p*-nitroso-N-dialkylanilines. A mechanism is proposed, in which the nitrosophenol reacts via its quinone monoxime tautomer with HNO_2 (or species in equilibrium with HNO_2) to produce an intermediate nitrosating agent which undergoes attack by the amine to produce the N-nitrosamine and regenerate the catalyst. RM

25

[Nitrosation of secondary amines in the presence of wheat bran.]

Cattaneo, P.; Cantoni, C.

Tecnica Molitoria 31 (9) 698–700 (1980) [3 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Studies were conducted to evaluate effects of wheat bran (present at levels of 0, 0.5, 2.0 or 4.0% in the reaction mixture) on nitrosation of dimethylamine (DMN) and diphenylamine (DPA) by $NaNO_2$ in aqueous solution at pH 2 or 6. The reaction mixture contained $NaNO_2$ at a concn. of 4 μg/ml, together with either DMA at 2 μg/ml or DPA at 6 μg/ml. The % nitrosation of the amines was evaluated colorimetrically after incubation of the reaction mixture for 24 h at 37°C. No nitrosation of DMA was observed in the absence of bran; nitrosation of DPA occurred in the absence of bran at pH 2, but not at pH 6. Even the lowest bran concn. tested promoted almost total nitrosation. However, 100% of the nitrosamine formed was absorbed by the bran. Implications for formation of nitrosamines in foods or within the alimentary tract are discussed, together with the possible absorption of dietary nitrosamines by bran, and their elimination from the alimentary tract. [See also FSTA (1981) 13 1M3.] AJDW

26

Nitrite sources and nitrosamine formation *in vitro* and *in vivo*.

Walters, C. L.; Carr, F. P. A.; Dyke, C. S.; Saxby, M. J.; Smith, P. L. R.

Food and Cosmetics Toxicology 17 (5) 473–479 (1979) [29 ref. En] [British Food Manufacturing Ind. Res. Ass., Randalls Rd., Leatherhead, Surrey, UK]

Consumption of salad-type meals rich in nitrate (90–115 mg) by normal adults, was followed by a rapid rise in salivary nitrite levels, and then by a fall towards the fasting nitrite levels. Nitrite level and pH of gastric contents increased markedly following consumption of a meal containing nitrate, reaching max. within about 45 min, then returning towards fasting levels. Studies were made in vitro and in vivo, using foods as sources of nitrosatable amines, on the formation of *N*-nitroso compounds under the conditions encountered in the human stomach, with special reference to the different thiocyanate concn. in smokers and non-smokers. Major volatile nitrosamines produced when foods were incubated with nitrite under acid conditions in vitro were *N*-nitrosopiperidine (NPIP) and *N*-nitrosopyrrolidine. At nitrite concn. likely to occur in the stomach, nitrosamine formation was reduced and was significantly lower in the absence of thiocyanate than in its presence at levels of 0.2–3mM. Trace amounts of NPIP were detected occasionally in the gastric contents of volunteers after ingestion of homogenized foods containing nitrite. VJG

27

Environmental carcinogens selected methods of analysis. Vol. 1. Analysis of volatile nitrosamines in food.

Preussmann, R.; Castegnaro, M.; Walker, E. A.; Wassermann, A. E. (International Agency for Research on Cancer) (Editors)

IARC Scientific Publications No. 18, xiii + 212pp. ISBN 92-832-1118-9 (1978) [many ref. En] [IARC, Lyon, France]

This book gives a detailed evaluation of the literature and details of methods available for the analysis of volatile nitrosamines. The 3 sections of the book are: Carcinogenicity of *N*-nitroso compounds (pp. 3–9); General review of approaches to nitrosamine analysis (pp. 13–77, including 21pp. of references); and Methods

of analysis (pp. 81-212). Individual chapters are as follows. Carcinogenicity of *N*-nitroso compounds and their possible role in the development of human cancer, by L. Griciute (pp. 3-9, 36 ref.). Sampling and samples, by T. Kawabata (pp. 13-14). Extraction and clean-up methods, by G. M. Telling (pp. 15-20). Final chromatography and detection, by N. P. Sen (pp. 21-27). Mass spectrometric techniques, by T. A. Gough (pp. 29-34). Derivative formation, by G. Eisenbrand (pp. 35-39). The use of chemiluminescence-based detectors, by D. H. Fine (pp. 41-42). A brief review of analytical methods for the determination of amines, by G. B. Neurath (pp. 43-47). A brief review of analytical methods for the determination of nitrate and nitrite in foodstuffs, by G. M. Telling (pp. 49-56). Analysis of volatile *N*-nitrosamines in food using flame thermionic detection and mass spectrometry confirmation, method 1, by T. Fazio, J. W. Howard & D. Havery (pp. 83-96); method 2, by T. Kawabata, M. Nakamura, M. Matsui & T. Ishibashi (pp. 97-107); and method 3, by W. Fiddler, J. W. Pensabene, J. C. Dooley & A. E. Wasserman (pp. 109-118). Analysis of volatil *N*-nitrosamines using gas chromatography with Coulson detector: estimation of *N*-nitrosopyrrolidine by TLC with fluorimetric detection, by N. P. Sen (pp. 119-131). Determination of volatile *N*-nitrosamines in food by chemiluminescence using the thermal energy analyser, by D. H. Fine (pp. 133-140). Mass spectrometric determination of volatile *N*-nitrosamines after screening by the Coulson electrolytic detector, by T. Gough & K. Webb (pp. 141-150). [Continued in following abstr.] AL

28

Environmental carcinogens selected methods of analysis. Vol. 1. Analysis of volatile nitrosamines in food.

Preussmann, R.; Castegnaro, M.; Walker, E. A.; Wassermann, A. E. (International Agency for Research on Cancer) (Editors)

IARC Scientific Publications No. 18, xiii + 212pp. ISBN 92-832-1118-9 (1978) [many ref. En] [IARC, Lyon, France]

[Continued from preceding abstr.] Meat and meat products - mass spectrometric determination of volatile *N*-nitrosamines, by R. W. Stephany, J. Freudenthal & P. L. Schuller (pp. 151-161). Mass spectrometric determination of volatile *N*-nitrosamines in food, by G. M. Telling, D. R. Hoar & T. A. Bryce (pp. 163-173). Analysis of volatile *N*-nitrosamines in food by electron capture and Coulson detection of their *N*-nitramine derivatives, by E. A. Walker, M. Castegnaro & B. Pignatelli (pp. 175-187). Analysis of volatile *N*-nitrosamines in meat products using oxidation of *N*-nitrosamines to *N*-nitramines and electron-capture detection of *N*-nitramines, by S. J. Kubacki & A. Borys (pp. 189-197). Analysis of volatile *N*-nitrosamines in food using N-specific detection and ion-specific determination of heptafluorobutyramides by gas chromatography/low-resolution mass spectrometry, by G. Eisenbrand & R. Preussmann (pp. 199-212). AL

29

[Hygienic studies on *N*-nitroso compounds. II. Survey of various foods for volatile *N*-nitroso compounds.]

Maki, T.; Tamura, Y.; Shimamura, Y.; Nishigaki, S.; Naoi, Y.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 29 (1) 256-260 (1978) [14 ref. Ja] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunincho 3 chome, Shinjuku-ku, Tokyo, 160 Japan]

This paper includes data for the concn. of volatile basic N, NO_2^- and various nitrosamines in samples of ham, fish sausage, whale meat bacon, canned meat and fish products, dried fish, shiokara (salted viscera), smoked fish, smoke-type flavourings, fish jelly, chicken, and eggs. The highest nitrosamine levels were recorded in dried fish products. [See FSTA (1980) 12 4C186 for part I.] AJDW

30

[Hygienic studies on *N*-nitroso compounds. III. Survey of processed foods and alcoholic beverages for volatile N-nitroso compounds.]

Maki, T.; Tamura, Y.; Shimamura, Y.; Koseki, M.; Nishigaki, S.; Naoi, Y.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 30 (1) 145-148 (1979) [10 ref. Ja] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunincho 3 chome, Shinjuku-ku, Tokyo, 160 Japan]

This paper includes data for the pH of and concn. of volatile basic N and various nitrosamines in samples of dried fish, katsuobushi, seasonings, heat-sterilized meat/vegetable products, miso, soy sauce, cheese, sake, sake lees, Japanese and imported beer, dried milk and eggs. The highest nitrosamine concn. were recorded for dried fish (152 parts/billion dimethylnitrosamine in fish dried using town gas burners). Dimethylnitrosamine was the main nitrosamine detected; a few samples also contained diethylnitrosamine. No nitrosamine was detected in seasonings, cheeses, sake or dried milk. [See preceding abstr. for part II.] AJDW

31

[Nitrosamines in meat and meat products.] [Review]

Klein, S.; Pipek, P.; Velisek, J.

Prumysl Potravin 31 (2) 75-77 (1980) [Cs] [Vysoka Skola Chemickotech., Prague, Czechoslovakia]

This review deals with formation of nitrosamines; effects of nitrite and amine concn.; dependence on pH, temp. and treatment duration; inhibitory and catalytic effects of some compounds; other formation possibilities; nitrosamine stability; effects on man; occurrence in foods; presence of nitrosamine-forming agents in foods; and effects of some food additives on nitrosamine formation. The bibliography of 33 references may be obtained from the author. SKK

32

The transnitrosation of *N*-methylaniline by a protein-bound nitrite model system in relation to *N*-nitrosamine formation in cured meats.
Dennis, M. J.; Massey, R. C.; McWeeny, D. J.
Journal of the Science of Food and Agriculture 31 (11) 1195–1200 (1980) [6 ref. En] [Min. of Agric. Fisheries & Food, Haldin House, Old Bank of England Court, Queen Street, Norwich NR2 4SX, UK]

The reactions of $NaNO_2$, *S*-nitrosocysteine hydrochloride, *S*-nitrosoglutathione and a 'protein-bound nitrite' model system with *N*-methylaniline at pH 5.5 and 37°C have been compared. Rate of nitrosamine formation from $NaNO_2$ and *S*-nitrosocysteine is greater than that from the model system although the latter depends upon the local concn. of nitrosothiol groups on the matrix. Transnitrosation by *S*-nitrosoglutathione is considerably slower than the other reactions. The implications of the results with respect to nitrosamine formation in cured meat are discussed. AS

33

An improved procedure for the determination of volatile *N*-nitrosamines in bacon grease by using the mineral oil distillation-thermal energy analyzer method.
Owens, J. L.; Kinast, O. E.
Journal of Agricultural and Food Chemistry 28 (6) 1262–1264 (1980) [20 ref. En] [Monsanto Ind. Chem., St. Louis, Missouri 63166, USA]

An improved method is described for determining volatile *N*-nitrosamines in [bacon and] rendered bacon fat at the part/billion level. A distillation aid comprised of silica gel and kaolin greatly improves *N*-nitrosamine recoveries for the mineral oil distillation procedure. The *N*-nitrosamines are analysed by gas chromatography with a Thermal Energy Analyzer detector. This procedure is a fast, selective, and reliable method for determining *N*-nitrosamines in bacon grease. AS

34

Food additives and cancer. [Review]
Fairweather, F. A.; Swann, C. A.
Proceedings of the Nutrition Society 40 (1) 21–30 (1981) [18 ref. En] [DHSS Toxicology Unit, Dominion House, 59 Bartholomew Close, W. Smithfield, London EC1A 7BE, UK]

Potential carcinogenicity of food additives is reviewed, in particular that of furyl furamide (AF-2), safrole, colours, artificial sweeteners, and nitrates, nitrites and nitrosamines. Use of in vitro screening and animal tests is discussed, as is the problem of evaluation of risk/benefit to food safety of banning a particular additive. DIH

35

Estimate of the volatile nitrosamine content of Japanese food.
Maki, T.; Tamura, Y.; Shimamura, Y.; Naoi, Y.
Bulletin of Environmental Contamination and Toxicology 25 (2) 257–261 (1980) [12 ref. En] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, 3-chome, Hyakunincho, Shinjuku-ku, Tokyo, 160 Japan]

370 samples of typical Japanese food, obtained from retailers in the Tokyo area from 1976 through 1980, were analysed for volatile nitrosamines by the Thermal Energy Analyzer-Gas Chromatography. Data are tabulated for the following foods: cured meat; canned fish; canned meat and vegetable; precooked frozen food; dried fish; boiled dried fish; smoked and flavoured fish; soused cuttlefish; katsuobushi; dairy products; egg and chicken; food seasoning and spice; margarine; mayonnaise; beer; sake; tsukemono (pickled vegetables); miso and shoyu; and rice. It is concluded from the results that the likely intake of *N*-nitrosodimethylamine per person from the Japanese diet is approx. 1.8 mg. VJG

36

[Occurrence of dimethylnitrosamine in commercial beers and its formation in the brewing process.]
Maki, T.; Tamura, Y.; Shimamura, Y.; Koseki, M.; Nishigaki, S.; Naoi, Y.
Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 21 (3) 184–188 (1980) [13 ref. Ja, en] [Tokyo Metropolitan Res. Lab. of Public Health, Hyakunin-cho 3-chome, Shinjuku-ku, Tokyo, Japan]

Commercial beers of different types obtained from retailers in Tokyo in 1979 were examined to detect the possible occurrence of NNA (N-nitrosamine) using a thermal energy analyzer and gas chromatography. It was found that 25 of 27 samples contained DMNA (dimethylnitrosamine) with a mean level of 1.7 parts/billion. No other NNA was detectable. As for the source of DMNA, it was found when the green malt was dried and kilned with fuel gas, and not so much when the green malt was treated with an electric desiccator. TM

37

[Occurrence of nitrosamines in silage and in bovine rumen contents and milk.] Zum Vorkommen von Nitrosaminen in Silage sowie Panseninhalt und Milch von Rindern. [Thesis]
Heerdegen, C.
62pp. (1979) [73 ref. De, en] Munich, Federal Republic of Germany; Fachbereich Tiermedizin, Ludwig-Maximilians-Universität [Inst. für Hygiene & Tech. der Lebensmittel Tierischen Ursprungs, Munich, Federal Republic of Germany]

Nitrate and nitrite contents of 17 milk samples ranged from 0.2 to 5.6 and 0 to 0.4 p.p.m., resp. During storage for 3–5 days at 6°C, the nitrite content of milk tended to increase, and increases were also found when milk was heated (especially at 120°C). Nitrosamines were not detected in silage or in any of the raw or heated milk samples. MEG

38

Increase in the nitrosamine content of several fish products upon broiling.
Matsui, M.; Ohshima, H.; Kawabata, T.
Bulletin of the Japanese Society of Scientific Fisheries [Nihon Suisan Gakkai-shi] 46 (5) 587–590

(1980) [17 ref. En] [Tokyo Res. Lab., Shimadzu Corp., 1-63-1 Shiasaki, Chofu-shi, Tokyo 182, Japan]

A total of 20 commercial fish and shellfish products consisting of 11 fish spp. were analysed before and after broiling on a city gas range for carcinogenic *N*-nitrosamines by using a nitrosamine specific detection technique (chemiluminescence detection). Mean concn. of *N*-nitrosodimethylamine (NDMA) in 15 uncooked fish products except dried squids was 2.4 μg/kg, and the max. value found was 9.4 μg/kg. Levels of nitrosamines in these products increased remarkably upon broiling, and the average value of NDMA of gas-broiled samples was 6.4 μg/kg, max. value 26.1 μg/kg. The NDMA content of 5 uncooked dried squids ranged from 15.4 to 84.0 μg/kg, average value 46.3 μg/kg; in contrast, those in gas-broiled squids ranged from 23.6 to 313 μg/kg, average value 130.2 μg/kg. Minute quantities of *N*-nitrosodiethylamine were detected when "akodai" fillets preserved in "sake"-lees were broiled; also *N*-nitrosopyrrolidine was detected when dried squid samples were broiled on a gas range or even on an electric range. Covering fish products with Al foil or broiling them on an electric range was found to be effective in decreasing NDMA formation. AS

39

A survey of nitrosamines in sausages and dry-cured meat products.

United States of America, Nitrite Safety Council

Food Technology 34 (7) 45–53, 103 (1980) [16 ref. En] [Sci. Dep., American Meat Inst., PO Box 3556, Washington, DC 20007, USA]

Frankfurters, bologna, sausages, meat loaves and a number of other products, all made from different meats, were treated in several ways i.e. frying, boiling, microwave heating, broiling or left cold, and analysed for proximate composition, residual cure ingredients and nitrosamines, by various laboratories. Tables of detailed results are given. Cooking was generally found not to increase the amount of nitrosamines formed, which was mostly < 1 part/billion anyway. *N*-nitrosopyrrolidine may occur in fried samples and especially in bacon, so further research is recommended. LH

40

[Nitrosation of pigments in sausages.]

D'Aubert, S.; Calcinardi, C.

Archivio Veterinario Italiano 31 (1/2) 3–4 (1980) [2 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi di Milano, Milan, Italy]

Studies were conducted on the pH and the % nitrosation of haem pigments in 21 samples of commercial sausages, 13 made with nitrite, 8 made without nitrite. No nitrosopigments were detected in the samples made without nitrite. % nitrosation of haem pigments in sausages made with nitrite ranged from 40 to 82.5%; there was a tendency for low pH to be associated with high % nitrosation. Model studies on sausage emulsions containing 150 p.p.m. nitrite and adjusted to various pH values showed the % nitrosation of haem pigments to be 5.8 at pH 6.7, 34.2 at pH 6, and 70 at pH 5. AJDW

41

Nitrosamine reduction.

Canada Packers Ltd.; Unilever Ltd.

British Patent. 1 569 179 (1980) [En]

The nitrosamine content of cooked meat products is reduced by employing curing solutions containing 1,2,3,4-tetrahydro-6-alkoxy quinolines. RAW

42

[Variations in the concentration of N-nitroso compounds in meat products processed with minimal amounts of nitrite.] Schwankungen in der Konzentration von N-Nitroso-Verbindungen in Fleischerzeugnissen, die mit minimalen Mengen an Nitrit hergestellt werden.

Preda, N.; Popa, L.

Fleischwirtschaft 60 (12) 2184–2186; 2211–2212 (1980) [16 ref. De, En] [Inst. of Med. & Pharmacy, Str. 1 Mai ur. 13, Cluj-Napoca, Romania]

6-yr studies on nitrite and nitrosamine levels in a variety of meat products produced the following results: fresh products, e.g. Pariser, Prague sausages, Prague ham etc., processed with $NaNO_2$, contained NO_2^- residues of 5–7 p.p.m. Smoked products, e.g. high-quality salamis, had NO_2^- residues of 4–6 p.p.m. Dried matured salamis of Sibiu type, which are processed with $NaNO_3$, had 4 p.p.m. NO_2^- in 12.9% of samples, < 3 p.p.m. in the rest, and no nitrosamines; in fresh products, 18.75% of samples contained nitrosamines (at ≤ 3 parts/billion). The results lend support to the Romanian legislation limiting NO_2^- residues to 7 p.p.m. No cases of botulism were reported after consumption of meat products made with these low NO_3^- or NO_2^- additions. RM

43

Effects of various concentrations of sodium nitrite and potassium sorbate on nitrosamine formation in commercially prepared bacon.

Robach, M. C.; Owens, J. L.; Paquette, M. W.; Sofos, J. N.; Busta, F. F.

Journal of Food Science 45 (5) 1280–1284 (1980) [15 ref. En] [Monsanto Co., 800 N. Lindbergh Boulevard, St. Louis, Missouri 63166, USA]

Pork bellies (270) were processed under regular commercial conditions using various concn. (5 treatments) of sodium nitrite and potassium sorbate. The bacon produced was stored at 3°C, then fried and tested for nitrosamines by gas chromatography-thermal energy analysis at 0 and 21 days after slicing. Nitrite and sorbate concn. were determined weekly during a 49-day period of 3°C storage. Bacon processed without sodium nitrite, regardless of sorbate concn. contained low (< 4.4 parts/billion) levels of *N*-nitrosopyrrolidine (NPYR) after being fried at 171°C for 3 min on each side. Bacon processed with 40 p.p.m. nitrite and 0.26% potassium sorbate contained an average of 8.7 parts/billion NPYR at zero time slicing) and 5.4 parts/billion after 21 days of 3°C storage under vacuum packaged conditions. Bacon with 80 parts/billion nitrite and 0.26% potassium sorbate had average NPYR levels of 14.3 parts/billion at zero time and 11.4 parts/billion after 21 days of

refrigerated storage. Bacon made with 120 parts/billion nitrite contained an average of 28.1 parts/billion NYPR at zero time and 16.2 parts/billion after 21 days at 3°C. After frying the bacon, 61–71% of the potassium sorbate remained in the product. Methods for nitrosamine analysis and sorbate detn. are described. IFT

44

[Use of thin layer chromatography on polyamide for fluorescence determination of N-nitrosamines.]
Zhukova, G. F.; Pimenova, V. V.; Medvedev, F. A.
Zhurnal Analiticheskoi Khimii 34 (8) 1621–1625 (1979) [12 ref. Ru, en] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

A method based on conversion of *N*-nitrosamines to the corresponding amines, their interaction with 1-dimethylaminonaphthalene-5-sulphochloride to form fluorescing compounds and subsequent TLC determination of polyamide is described. Tests with nitrosamines added to foods at 23–32 µg/kg showed recoveries of 72–84%. Poshekhonskii cheese, cream and tvorog were examined by the method described; contents of *N*-nitrosodimethylamine, *N*-nitrosodiethylamine, and *N*-nitrosopiperidine (the only nitrosamines detected) were, resp. (µg/kg): cheese, 1–9, 2–5 and traces; cream, none; tvorog, traces, 1–7 and traces. The contents in these foods were confirmed by MS. SKK

45

[Sources of nitrosamines in foods of animal origin.]
Juszkiewicz, T.
Medycyna Weterynaryjna 34 (7) 412–415 (1978) [8 ref. Pl] [Zakładu Farmakologii i Toksykologii Inst. Weterynari, Pulawy, Poland]

Aspects considered in this discussion of sources of nitrosamines in meat, poultry, fish, eggs and milk include de novo formation of nitrosamines in the gastrointestinal tract of the animal (with reference to the importance of the nitrate and nitrite content of the feed), and transfer of preformed nitrosamines from the feed to the edible tissues or milk. AJDW

46

Volatile nitrosamines in food.
Spiegelhalder, B.; Eisenbrand, G.; Preussmann, R.
Oncology 37 (4) 211–216 (1980) [15 ref. En] [German Cancer Res. Cent., Inst. of Toxicology & Chemotherapy, Heidelberg, Federal Republic of Germany]

A selection of 2826 food samples (including meat and meat products, cheese and beer), representing average Federal German consumption, was analysed for nitrosamines. 3 nitrosamines were found consistently (*N*-nitroso-dimethylamine, NDMA; *N*-nitroso-pyrrolidine, NPYR; and *N*-nitrosopiperidine, NPIP); NPYR and NPIP were found at concn. >0.5 µg/kg in only 3 and 2% of samples, resp. NDMA was detectable in 30% of samples, 6% containing >5 µg/kg. Average daily male intake of NDMA was 1.1 µg, about 64% of which came from beer (and can be eliminated by adjusting the kilning of the malt), and only 10% from cured meat. Changes in concn. of NDMA in beer during various brewing stages and in malt during kilning are tabulated. LH

47

Synergistic effect of chlorogenic acid and thiocyanate on in vitro formation of *N*-methyl-*N*-nitrosoaniline under physiological conditions.
Lathia, D.; Frentzen, U.
Food and Cosmetics Toxicology 18 (5) 463–465 (1980) [14 ref. En] [Fachhochschule Niederrhein, Fachbereich Ernährung/Hauswirtschaft, Richard-Wagner-Str. 101, 4050 Mönchengladbach, Federal Republic of Germany]

Rate of formation of *N*-methyl-*N*-nitrosoaniline (NMNA) from nitrite and *N*-methylaniline in the presence of (i) chlorogenic acid (a phenolic component of coffee) and/or (ii) thiocyanate at levels likely to be encountered in vivo was studied in a series of in vitro reactions. (i) had a marked catalytic effect, directly related to its concn., (ii) also catalysed NMNA formation. (i) and (ii) had a cumulative effect on the reaction. Increase in NMNA yield was indirectly proportional to (i) concn. at constant level of (ii). These results indicate that (i) and (ii) may have some synergistic effect on in vivo nitrosamine formation if ingested simultaneously, and may thus significantly increase human exposure to carcinogenic nitrosamines. VJG

48

Nitrosamines in malt and malt beverages.
Havery, D. C.; Hotchkiss, J. H.; Fazio, T.
Journal of Food Science 46 (2) 501–505 (1981) [11 ref. En] [Div. of Chem. & Physics, Bureau of Foods, FDA, 200 C Street, SW, Washington, DC 20204, USA]

National and local surveys of barley malt and barley malt-containing beverages for volatile *N*-nitrosamines were conducted by the FDA. 64 samples of locally purchased beers had an average *N*-nitrosodimethylamine (NDMA) content of 3 µl/l. Eleven of 44 Scotch whiskies had nondetectable NDMA levels. A national sampling of domestic and imported malts revealed that 84% had NDMA concn. of <10 µl/l. Domestic and imported beers were also surveyed in a compliance programme; 260 beer samples (180 domestic, 80 import) were analysed. The domestic beers averaged <1 µl/l. These data indicate that levels of NDMA in beer have been reduced significantly. IFT

49

Investigations of edible oils for volatile nitrosamines.
Fiddler, W.; Pensabene, J. W.; Kimoto, W. I.
Journal of Food Science 46 (2) 603–605 (1981) [12 ref. En] [USDA-SEA, E. Reg. Res. Cent., 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

21 commercial edible oils and 5 margarine samples were purchased locally and analysed for nitrosamines (NA) by a gas-liquid chromatograph interfaced with a Thermal Energy Analyzer. *N*-nitrosodimethylamine (NDMA), at levels of 0.22–1.01 µg/kg, was the only volatile apparent NA detected. These levels were found in 7/7 corn, 6/6 olive, 2/2 sunflower, 1/3 soybean, 2/3 undesignated oils, and 4/5 margarine samples. The other 3 oils and 1 margarine sample showed no NDMA at the lower limit of 0.1 µg/kg. These levels of nitrosamine detected in the edible oils tested were much lower than levels previously reported. IFT

50

[Occurrence of nitrosamines in feedstuffs and milk.] Zum Vorkommen von Nitrosaminen in Futtermitteln und Milch. [Lecture]
Terplan, G.
Deutsche Tierärztliche Wochenschrift 87 (6) 236–237 (1980) [1 ref. De] [Lehrstuhl für Hygiene & Tech. der Milch, Univ. München, Munich, Federal Republic of Germany]

Nitrosamine formation can occur in silage but it is doubtful whether it can be transferred to the udder. Nitrate reducing bacteria contaminating milk may catalyse nitrosamine formation; milk itself or its enzymic activity may prevent nitrosamine formation. [See FSTA (1981) 13 9P1584.] BR

51

***N*-nitrosodimethylamine in dried dairy products.**
Libbey, L. M.; Scanlan, R. A.; Barbour, J. F.
Food and Cosmetics Toxicology 18 (5) 459–461 (1980) [12 ref. En] [Dep. of Food Sci. & Tech., Oregon State Univ., Corvallis, Oregon 97331, USA]

7 dried skim milks and 2 dried buttermilks purchased from local retail outlets were analysed for volatile nitrosamines using a chemiluminescence detector. 50 g of sample and 70 ml of mineral oil were used in the vacuum distillation procedure. The distillate extracts were quantitatively analysed on a gas chromatograph interfaced to a thermal energy analyser (GC-TEA). *N*-nitrosodimethylamine (NDMA) the only volatile nitrosamine that could be confirmed to be present by MS, was detected in 8 out of 9 samples analysed. The mean level of NDMA for all samples was 1.9 parts/10^9, and the range was 0–4.5 parts/10^9. NDMA was confirmed by MS in 5 of the samples. The study indicates that the presence of low levels of NDMA in dried dairy products may be general. VJG

52

Survey of fluid and nonfat dry milks for *N*-nitrosamines.
Lakritz, L.; Pensabene, J. W.
Journal of Dairy Science 64 (3) 371–374 (1981) [17 ref. En] [E. Reg. Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

A limited survey of milk and milk products was undertaken to determine the presence of volatile *N*-nitrosamines, a class of compounds carcinogenic to a broad range of animal species. Nitrosamines were detected and estimated by GLC interfaced with a Thermal Energy Analyzer. Detectable *N*-nitrosodimethylamine, the only nitrosamine found, ranged from 0.05 µg/kg for whole milk to 0.30 µg/kg for dried skim milk. No *N*-nitrosodimethylamine was detected in raw milk, whereas 11 of 21 samples of pasteurized milk contained apparent *N*-nitrosodimethylamine (mean 10 µg/kg). *N*-nitrosodimethylamine was also detected, but not confirmed by mass spectrometry, in evaporated and condensed milk with means 0.32 and 0.58 µg/kg and in 9 of 10 dried skim milk samples with a mean of 1.69 µg/kg. Upon reconstitution, condensed milk and dried skim milk contained *N*-nitrosodimethylamine comparable with that in pasteurized milk. No *N*-nitrosodimethylamine was detected in cultured milk products such as buttermilk and yoghurt. AS

53

Environmental aspects of *N*-nitroso compounds. [Conference proceedings]
Walker, E. A.; Castegnaro, M.; Griciute, L.; Lyle, R. E. (International Agency for Research on Cancer) (Editors)
IARC Scientific Publications No. 19, xxiv + 556pp. ISBN 92-832-1119-7 (1978) [many ref. En] [Lyon, France]

This book contains the Proceedings of a Working Conference held at the New England Center for Continuing Education, University of New Hampshire, Durham, New Hampshire, USA, on 22–24 Aug. 1977. The book contains sections dealing with Analysis (pp. 1–95); Chemistry and fermentation (pp. 97–264); Occurrence and precursors (pp. 265–439); Biology (pp. 441–513); Safety (pp. 515–543); and Subcommittee reports and recommendations (pp. 545–561). Individual papers include the following. Survey of cured meat products for volatile *N*-nitrosamines: comparison of 2 analytical methods, by D. C. Havery, T. Fazio & J. W. Howard (pp. 41–52, 24 ref.). New data from collaborative studies on analysis of nitrosamines [in processed meat], by M. Castegnaro & E. A. Walker (pp. 53–62, 2 ref.). Studies related to nitrosamide formation: nitrosation in solvent:water and solvent systems, nitrosomethylurea formation in the rat stomach and analysis of a fish product for ureas, by S. S. Mirvish, K. Karlowski, J. P. Sams & S. D. Arnold (pp. 161–174, 13 ref.). α-Tocopherol: uses in preventing nitrosamine formation, by W. J. Mergens, J. J. Kamm, H. L. Newmark, W. Fiddler & J. Pensabene (pp. 199–212, 24 ref.). Formation of nitrosodimethylamine by microorganisms used in the baking industry or isolated from the raw materials of bakery products, by J. Uibu, P. Bogovski & O. Tauts (pp. 247–256, 17 ref.). An assessment of human exposure to *N*-nitroso compounds, by D. H. Fine (pp. 267–278, 37 ref.). Possible breakdown of volatile *N*-nitrosamines by enzymatic and/or microbiological agents in Swiss raw sausage, by E. Hauser & H. J. Heiz (pp. 289–296). An examination of some foodstuffs for trace amounts of volatile nitrosamines using the thermal energy analyzer, by T. A. Gough (pp. 297–304, 13 ref.). Trends in levels of *N*-nitrosopyrrolidine in fried bacon, by D. C. Havery, T. Fazio & J. W. Howard (pp. 305–310, 5 ref.). Volatile and non-volatile *N*-nitroso compounds in foods and other environmental media, by G. Eisenbrand, B. Spiegelhalder, C. Janzowski, J. Kann & R. Preussmann (pp. 311–324, 4 ref.). *N*-nitroso-3-hydroxypyrrolidine in fried bacon and fried out fat, by J. S. Lee, L. M. Libbey, R. A. Scanlan & J. Barbour (pp. 325–332, 12 ref.). Recent studies in Canada on the analysis and occurrence of volatile and non-volatile *N*-nitroso compounds in foods, by N. P. Sen, B. A. Donaldson, S. Seaman, J. R. Iyengar & W. F. Miles (pp. 373–393, 35 ref.). Occurrence of methylguanidine and agmatine in foods [fish, shellfish and meat], by T. Kawabata, H. Ohshima & M. Ino (pp. 415–423, 16 ref.). Absorption, tissue deposition and passage into eggs of *N*-nitrosodimethylamine in hens, by T. Juszkiewicz & B. Kowalski (pp. 433–439, 7 ref.). AL

54

[Methods for production of beers free of nitrosamine.] Wege zum nitrosaminfreien Bier.
Altemark, D.; Hess, R.; Sommers, H.
Monatsschrift für Brauerei 33 (11) 415–418, 420–422 (1980) [4 ref. De, en, fr] [Ruhrgas AG, Essen, Federal Republic of Germany]

The potential for minimization of nitrosamine contents of beer is discussed, with special reference to reduction of nitrosamine formation attributable to presence of nitrogen oxides in hot air used for kilning of the malt. Use of sulphitation during kilning for minimization of nitrosamine formation is considered. The relative merits of indirect and direct heating of drying air are discussed, with special reference to the lower thermal efficiency and greater equipment requirement of the former, and hazards of nitrogen oxides in drying air of the latter. The isotherm process is described. This uses a special natural gas burner giving drying air low in nitrogen oxides; it retains the higher thermal efficiency of direct drying. AJDW

55

[Origin and significance of foreign substances in foods, especially in beer.]
Basarova, G.
Kvasny Prumysl 27 (1) 6–15 (1981) [31 ref. Cs, ru, en, de] [Vyzkumny Ustav Pivovarsky a Sladarsky, Prague, Czechoslovakia]

Various high resolution methods for identifying trace amounts of foreign matter in foods are outlined. In the case of malt and beer, residues of insecticides based on chlorinated hydrocarbons, organophosphates, and organic and inorganic metals compounds are investigated routinely, along with heavy metals residues (in beer). The stringent controls ensure that no Czechoslovak beers exceed the limits specified by the Czechoslovak Ministry of health for contents of these substances. Control of potentially carcinogenic nitrosamines is on a world-wide scale. STI

56

Determination of *N*-nitrosodimethylamine in malt and beer with TEA-GC system.
Tezuka, T.; Sakuma, S.; Katayama, H.
Report of the Research Laboratories of Kirin Brewery Co., Ltd. No. 22, 51–54 (1979) [9 ref. En]

A procedure was specified for rapid detn. of *N*-nitrosodimethylamine (NDMA) in malt and beer. A ground malt sample was suspended in water and the resultant suspension was subjected to dichloromethane extraction. A beer sample was directly extracted. Extraction with dichloromethane was repeated twice after decomposition of nitrite with ammonium sulphamate. The extract was dried over anhydrous Na_2SO_4, concentrated with a Kuderna-Danish evaporator and examined by gas chromatography with a thermal energy analyzer. The recovery of NDMA was 85% in malt and 92% in beer. The detection limit was 1.0 parts/billion in malt and 0.15 parts/billion in beer. AS

57

Mutagenicity of peanut oils and effect of repeated cooking.
Fong, L. Y. Y.; Ton, C. C. T.; Koonanuwatchaidet, P.; Huang, D. P.
Food and Cosmetics Toxicology 18 (5) 467–470 (1980) [16 ref. En] [Dep. of Biochem., Univ. of Hong Kong, Hong Kong]

4 samples of peanut oils obtained from local markets in Hong Kong were tested for mutagenicity using the Salmonella/microsomal test system. In the presence of microsomes, dimethylsulphoxide (DMSO) extracts of all of the samples were mutagenic to *Salmonella typhimurium* strains TA98 and TA100, but the mutagenic activity of the oils decreased after they had been repeatedly cooked. However, when the extracts were pre-incubated with the bacteria (TA100) and microsomes the mutagenic activity of the cooked oils was greater than that of the uncooked oils, suggesting the possible contamination of the cooked oils by N-nitrosamines. Mutagenic activity was also detected in random samples of 7 other brands of uncooked oils obtained from local markets. By absorption spectrophotometry aflatoxin B_1 levels in 3 of these oils were found to range from 98 to 150 µg/kg. DMSO-extracts of 10 samples of poor-grade market peanuts were also mutagenic and the peanut contained 95–1055 µg aflatoxin B_1/kg. The contamination of local peanut oils by mutagens before and after repeated cooking is concerning, since in 90% of Chinese households in Hong Kong peanut oils are used daily for cooking and are habitually saved and re-used repeatedly. AS

58

Detection of dimethyl- and diethylnitrosamine in a Nigerian fermented milk product (nono).
Maduagwu, E. N.; Bassir, O.
Toxicology Letters 4 (3) 169–173 (1979) [10 ref. En] [Dep. of Biochem., Univ. of Ibadan, Nigeria]

Nono is a fermented skim milk sold in Northern Nigeria. Dimethyl- and diethylnitrosamine were detected by TLC of a dichloromethane extract of a steam distillate from 20 l nono, and confirmed by MS. Using GLC, the 2 nitrosamines were estimated to be present at 3.4 and 2.9 µg/kg nono. [See also FSTA (1978) 10 7H884.] JMD

59

Adds culture to bacon, eliminates nitrosamines.
Antrup, C.; Andres, C.
Food Processing 41 (7) 76–77 (1980) [En]

Research has indicated that the use of starter cultures in the preparation of bacon products will effectively reduce residual nitrite concn., and hence the potential for nitrosamine formation. The culture promotes the formation of lactic acid in the curing brine, reducing the pH of the meat when smoked. The low pH and the consequent reduction in nitrite concn. in the cured product both contribute to the reduced formation of nitrosamines in the bacon at the time of frying. The use of the culture does not affect the flavour or any other quality attribute of the finished bacon. JRR

60

Compositions containing *N*-nitrosamine formation or oxidation inhibitors and the use thereof.
Gruetzmacher, G. D.; Czuba, L. J. (Pfizer Inc.)
United States Patent 4 251 563 (1981) [En]

Compositions of nitrite preserved food, emulsified preparations, breakfast, cereal or food premixes were made, containing erythorbyl or ascorbyl laurate or erythorbyl caprate. Substantial inhibition of potentially harmful or objectionable degradation arising from *N*-nitrosamine formation or oxidation was observed. Foods prepared include bologna, bacon pickle solution, mayonnaise and cornflakes. RAW

61

Effect of Japanese green tea on nitrosamine formation in vitro.
Nakamura, M.; Kawabata, T.
Journal of Food Science 46 (1) 306–307 (1981) [9 ref. En] [Dep. of Food & Drug Sci., Kanagawa Prefectural Public Health Lab., 52-2 Makao-cho, Asahi-ku, Yokohama, Kanagawa-ken 241, Japan]

Effect of Japanese green tea extract and various phenolic components of green tea on nitrosamine formation in vitro were investigated. We found that green tea extract seems to enhance the nitrosation of 4 secondary amines under acidic conditions; however, there exists an optimum concn. for the catalytic effect on nitrosamine formation. Among various polyphenols in Japanese green tea, only catechins catalyse nitrosamine formation, while pyrocatechol, pyrogallol and gallic acid inhibit the reaction. No significant effect on the nitrosation reaction could be observed in the presence of either flavonols or flavones. IFT

62

Investigations on the occurrence of nitrosamines in some agricultural and horticultural products.
Kofoed, A. D.; Nemming, O.; Brunfeldt, K.; Nebelin, E.; Thomsen, J.
Acta Agriculturae Scandinavica 31 (1) 40–48 (1981) [26 ref. En] [State Exp. Sta., Vejenvej 55, Askov, DK-6600 Vejen, Denmark]

Investigations were performed in 1978 to study modern cultivation methods and their effect on nitrosamine occurrence. Crops were fertilized with manure + fertilizer, solely fertilizer, or with sewage sludge, and samples taken for analysis by gas chromatography. Crops showing traces of nitrosamines were carrots and potatoes (N-nitrosodimethylamine at <0.3 μg/kg and N-nitrosodibutylamine at <0.6 μg/kg, resp.) and these traces were not verified by MS. It is concluded that appropriate utilization of normal amounts of fertilizers does not affect occurrence of volatile nitrosamines in plants, at harvest. LH

63

Mutagens in food as causes of cancer.
Sugimura, T.; Kawachi, T.; Nagao, M.; Yahagi, T.
Progress in Cancer Research and Therapy 17, 59–71 (1981) [64 ref. En] [Nat. Cancer Cent. Res. Inst., Tsukiji 5-1-1, Chuo-ku, Tokyo 104, Japan]

Aspects of the topic considered are: the food preservative AF-2; mutagens produced during cooking; and nitrosamines, endogenous formation of mutagens. VJG

64

Management of assessed risk for carcinogens.
Nicholson, W. J. (Editor)
Annals of the New York Academy of Sciences 363, 301pp. (1981) [En] [Dep. of Community Med., Mount Sinai School of Med., City Univ. of New York, New York 10029, USA]

This issue is devoted to a workshop, held by the New York Academy of Sciences on 17–19 March, 1980, to discuss some of the problems associated with the regulation of carcinogenic materials, with the emphasis on management of carcinogenic risk rather than on its determination. Regulation of carcinogens in foods, by J. V. Rodricks (pp. 29–35) discusses the 3 types of chemicals with possible carcinogenic effects in foods. These are: naturally-occurring toxins; chemicals added directly (e.g. as preservatives, stabilizers etc.) or indirectly (e.g. migrating from packaging materials, drug residues etc.); and contaminants resulting from microbial growth in improperly stored foods or from industrial chemicals polluting the environment. Steps taken in the USA by the Food and Drug Administration to ensure the safety of foods are discussed. Comments on this communication by P. F. Hopper (pp. 37–41) are also given. MEG

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